

Semilla Nueva Standard Report

First Semester January – June 2021

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EXECUTIVE SUMMARY

In 2018, Semilla Nueva began sales of biofortified maize seeds in Guatemala, a country with the world's fifth-highest rate of chronic malnutrition. Our theory of change was simple. If we could sell biofortified seeds at the right price, then enough farmers would grow them to flood the market with more nutritious grain which would improve the diet of the majority of the poor, maize-consuming population in Guatemala. This would be a cost-effective, scalable, culturally acceptable, and self-sustaining solution.

In our first and second years, we focused on selling biofortified seeds and understanding the feasibility of our idea. With the insight gained, we planned to develop better-biofortified seeds which were more responsive to the local context, gather much more rigorous evidence, and work with the Guatemalan government to create the policies that could make these seeds widely available. In our third year, 2020, we began to invest heavily into this second wave of activities. The preliminary results of this effort during the first six months of 2021 show we are building the foundations for national (and international) scale.

Overall, the results have been highly encouraging. They also have helped us to tune our expectations and prioritize our investments. By developing and launching new seeds, continuing to expand our sales, and building pilots of new public policies (with the government, seed companies, and donors), we can simultaneously increase the numbers of farmers and consumers we are reaching in the short term while developing the strategies to expand to hundreds of thousands of families in the medium term. This report complements our three-year plan and shows our current advances, problems, and areas of focus to make this possible. It covers our evaluation of impact, field programs, collaborations with other organizations, seed development, and our financials.

Impact Evaluation:

- Semilla Nueva reached 10,079 farming families in the first six months of 2021, slightly higher than our total families reached in 2020. We are well on track to reach our goal of 11,000 families by the end of the year.
- Families who planted biofortified seeds are eating biofortified maize for 72% of the year following their harvest, showing that families clearly prefer the taste of biofortified grain compared to the conventional grain they also harvest.
- Our first third-party nutritional impact study is progressing and will report results in late 2021.
- Finally, farmers in our largest customer segment enjoyed significant income increases of US\$218/farmer. However, mid-segment farmers who purchased Fortaleza F3 instead of more expensive seeds had slight losses (US\$-49/farmer).

Sales, Production, and Marketing:

- Semilla Nueva's seed production team produced sufficient seed for the year and corrected the quality control problems we faced in 2020. Higher quality seed contributed to the better economic returns for farmers mentioned above.
- Sales of our Fortaleza F3 seed grew 15% year to date. Semilla Nueva did not achieve all our promotional goals largely due to COVID-19 restrictions and a significant portion of the sales team having COVID-19 during the sales season. Sales increased in cooler regions where the seed has better performance and in regions where grain buyers don't dock farmers for the smaller,



darker grain produced by Fortaleza F3. Sales decreased significantly in Guatemala's most tropical region where price penalties for grain size and color are more severe.

- Semilla Nueva's sales team began the pre-launch of our new biofortified seed, Fortaleza F5. The seed has been planted in demonstration parcels throughout the country and provided to leading farmers. Field days will begin in late 2021 and sales will start in early 2022 pending results.
- Semilla Nueva developed a new pricing strategy as part of our efforts to involve other seed companies in the production and sale of biofortified seeds. The new pricing structure was partially implemented, and additional efforts will be necessary to improve use of the new prices by retailers.

Collaborations and Public Policy:

- Semilla Nueva's 2020 investments in coalition building, meetings with the government, and work with the media paid off. The Guatemalan Minister of Agriculture and President continue to mention biofortified seeds as one of their top agricultural priorities. The Guatemalan government launched its most significant program yet to produce and distribute free biofortified seeds to subsistence farmers. Initial estimates indicate the program reached 30-60,000 families between April and June 2021.
- The Guatemalan government is working with Semilla Nueva to obtain significant funding from international donors to: 1) expand the government's and Semilla Nueva's seed development efforts; 2) expand promotion of biofortified seeds; and 3) incentivize the private seed sector to expand the use of biofortified seeds.
- Semilla Nueva's pilot partnership with Guatemala's largest seed company, Valle Verde, proved initially successful. Valle Verde received a small subsidy for producing and selling biofortified seeds at reduced prices. Valle Verde reached just under 1,000 farmers in April-June 2021, with additional sales planned over the rest of the year. They plan to expand the program in 2022.
- Semilla Nueva allied with several NGOs and farmer associations to provide non-commercial biofortified seeds to 2,965 families in some of Guatemala's most marginalized regions.

Research and Development:

- Semilla Nueva's micronutrient lab is in full operation. It has analyzed more than 1,000 samples in its first 6 weeks of operation, compared to just over 300 samples that Semilla Nueva had analyzed in third-party labs during the previous 6 years.
- Using the new lab, Semilla Nueva analyzed our first batch of new, experimental biofortified seeds. The process met expectations, with a small percentage showing levels of zinc comparable to Semilla Nueva's current seeds. Further crosses are required, but this first proof of concept shows initial feasibility that the process can develop the much higher yielding seeds needed to rapidly make biofortified seeds truly competitive on the open market.
- Semilla Nueva has also developed an experimental seed with far better grain size and color to address penalties applied by grain buyers. This new seed is in its second year of testing and may be ready for pre-launch in 2022 and a full commercial launch in 2024.



IMPACT EVALUATION

Summary:

- 10,079 families planted Semilla Nueva's biofortified Fortaleza F3 maize seed between January and June of 2021, similar to the total number of families who planted in 2020. We are well on track to reach our goal of 11,000 families by the end of the year.
- 72% of the maize consumed by families that planted biofortified seed in 2020 was biofortified.
- Central America's leading nutrition institute, the International Center for Nutrition of Central America and Panama (INCAP) has finished fieldwork and is preparing data analysis for our first third-party nutritional impact study. The study will review the nutritional intake of farmers and determine the additional nutritional intake resulting from families having produced and consumed biofortified maize seeds. Results should be available by late 2021.
- Farmers in Semilla Nueva's largest customer segment made US\$218 more with Semilla Nueva's seed when compared to farmers using conventional seed. Mid-segment farmers who pay up to twice as much for seed lost US\$49.
- Semilla Nueva hired a Program Development and Reporting Sub-Director who will expand our M&E and data analysis capacity.

Semilla Nueva's 2020 annual consumption survey concluded that 72% of the maize consumed by an average family planting our seed was biofortified

Every year, Semilla Nueva conducts an annual consumption survey to understand: 1) the amount of biofortified maize that is consumed by farmers' families who plant and harvest biofortified maize, 2) the amount of biofortified maize sold to the market, and 3) basic demographic information of the farmers who used biofortified seed. This year for the first time, Semilla Nueva used phone surveys. The following are our key takeaways:

- 96 farmers were interviewed. In 2020, 76% of them bought Fortaleza F3 seed at agro-dealers that are part of our promoter program. The remaining 24% received free biofortified seed as part of our COVID-19 Seed Distribution program.
- 93% of the surveyed farmers stored at least a portion of the Fortaleza F3 maize harvested in 2020 for their consumption.
- Farmers saved an average of 0.63 Mg¹ of Fortaleza F3 maize for home consumption. Farmers harvested an average of 5.4 Mg of Fortaleza F3 and sold an average of 4.1 Mg.
- 57% of the surveyed families sold at least part of their Fortaleza F3 maize.
- 72% of maize projected to be consumed over a calendar year by the farmers surveyed was Fortaleza F3 maize. This is a 7% increase from 2019 and a 64% increase from 2018.

¹ Mg = Megagram. This is equal to 1,000Kg or one Metric Ton.

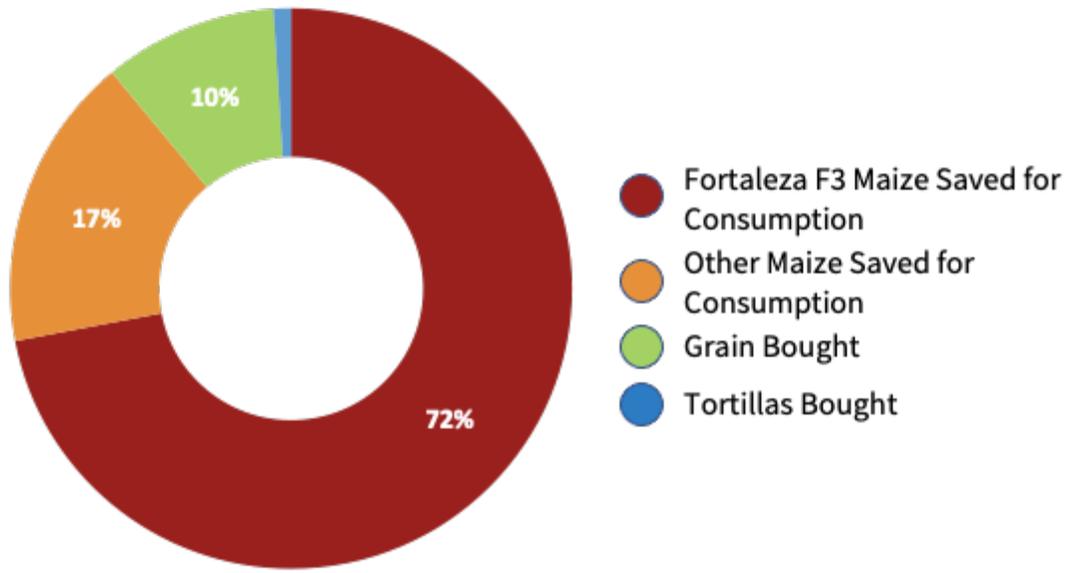


Figure 1. Sources of maize consumed annually among farming families interviewed

Positive economic impacts for our largest customer demographic, low-segment farmers, was US\$218 per farmer. Economic impacts in the mid-segment still showed losses using Fortaleza F3 vs. other more expensive conventional seeds

In some regions, farmers can plant a second maize crop during an extended rainy season between October and April, and some others have irrigation. Between October 2020 and June 2021, Semilla Nueva's sales team monitored the costs and yields of 19 of these farmers in the Eastern, Northern, and Southern regions of the country. Participating farmers planted both Fortaleza F3 and a competitor's seed and used the same farming practices and agricultural inputs for both seeds. Across regions, low-segment farmers gained the most money from planting Fortaleza F3, earning an extra US\$445/ha; since farmers plant an average of 0.49 ha, this translates into an estimated income boost of US\$218 per farmer, a substantial sum for poor farmers.

Compared to seeds which cost approximately 50% more in the mid-segment, Fortaleza F3 resulted in a small loss in farmer income. The table below shows our customer base and how economic impacts per farmer in each segment have changed over the last two years.



Table 1: Comparison of farmer income increase per segment by year and season

Fortaleza F3 vs competitor increased income by year and season (US\$/Farmer)				
Segment	2019	2019/20	2020	2020/21
	Rainy Season	Irrigation Season	Rainy Season	Irrigation Season
Mid-segment farmers	46	-2	-75	-49
Low-segment farmers	37	48	-70	218
Non-hybrid farmers (purchased or saved seed)	-	43	229	-
Non-hybrid farmers (received seed for free)	-	-	39	-

Semilla Nueva hired Marcel Janssen as Program Development and Reporting Sub-Director

Marcel will expand our impact evaluation capabilities and manage bilateral grant proposals and reporting. The new sub-director has 30 years of experience working on international development projects, primarily leading M&E, including 11 years of experience working in Guatemala as deputy chief of party and chief of party in other countries for large USAID programs. We are excited to welcome him to the team.

Semilla Nueva is on track to reach our 2021 goal of 11,000 families using biofortified maize, with 10,079 families having planted in the first 6 months of the year

Semilla Nueva reached more farmers in the first 6 months of 2021 (10,079) than the entirety of 2020 (9,936). Increases were seen in farmers reached through Semilla Nueva sales as well as our seed distribution program. Farmers reached through collaborations decreased slightly, due to Semilla Nueva's long-standing partners, farming associations ATESCATEL and APALH selling most of their seed to the Guatemalan government for their seed distribution program.

It is important to note that this impact evaluation does not yet take into account the many families reached through the new governmental programs launched in 2021, which are estimated to reach between 30,000-60,000 families. Semilla Nueva does not yet have data on these farmers but is collaborating with the Guatemalan government to explore impact evaluations for these programs.

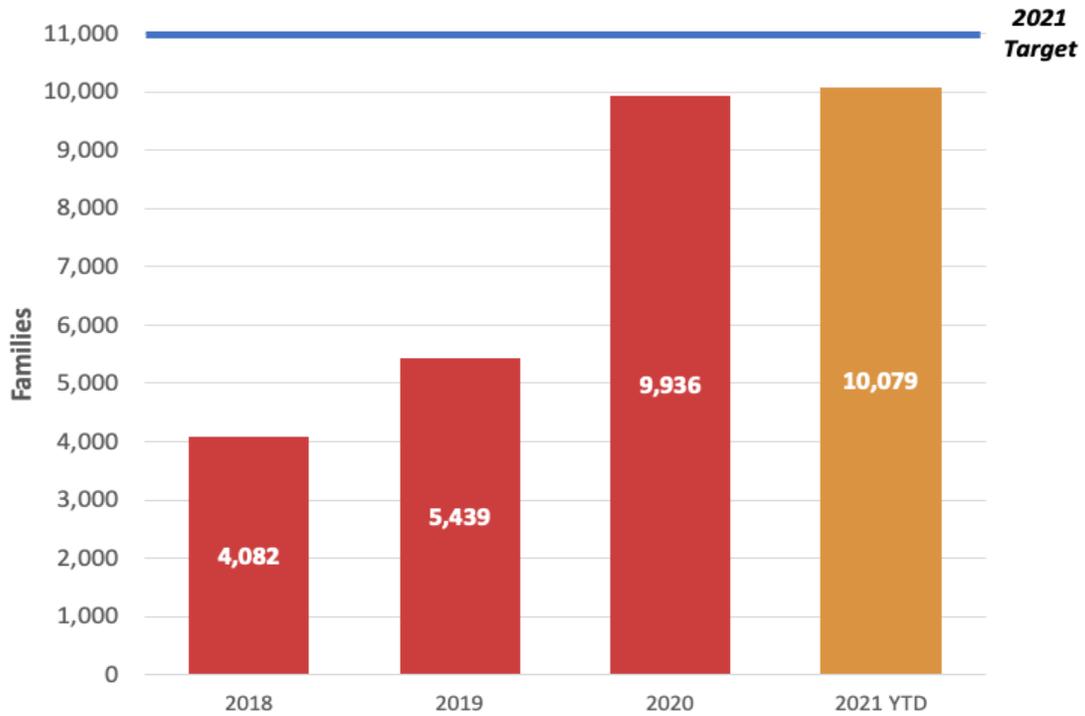


Figure 2: Families planting biofortified maize (excluding governmental programs).

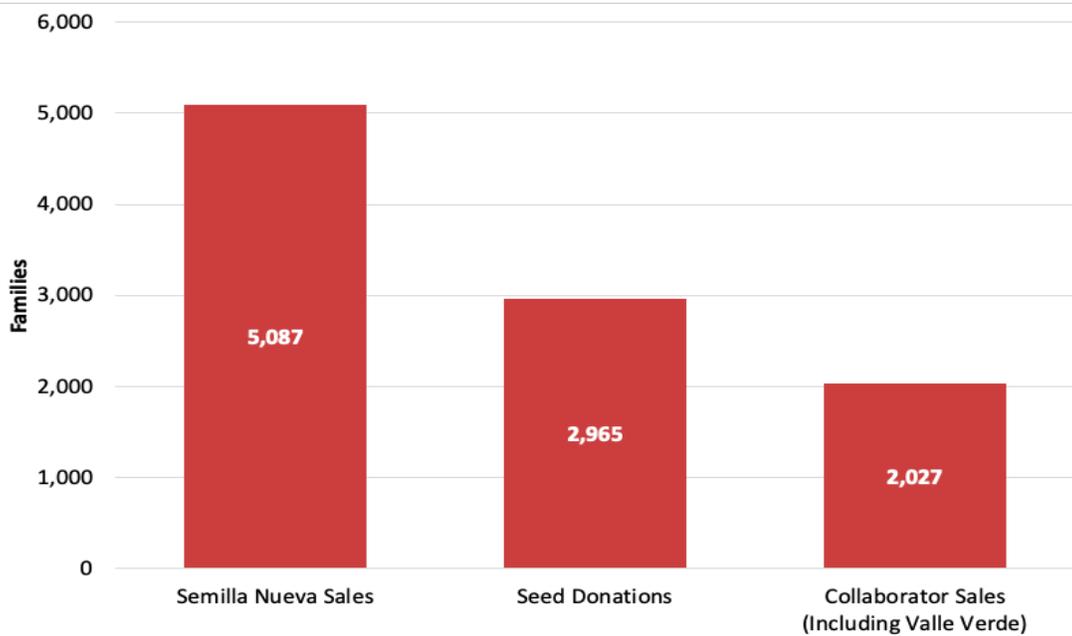


Figure 3: Seed sources for biofortified maize, Jan-June 2021

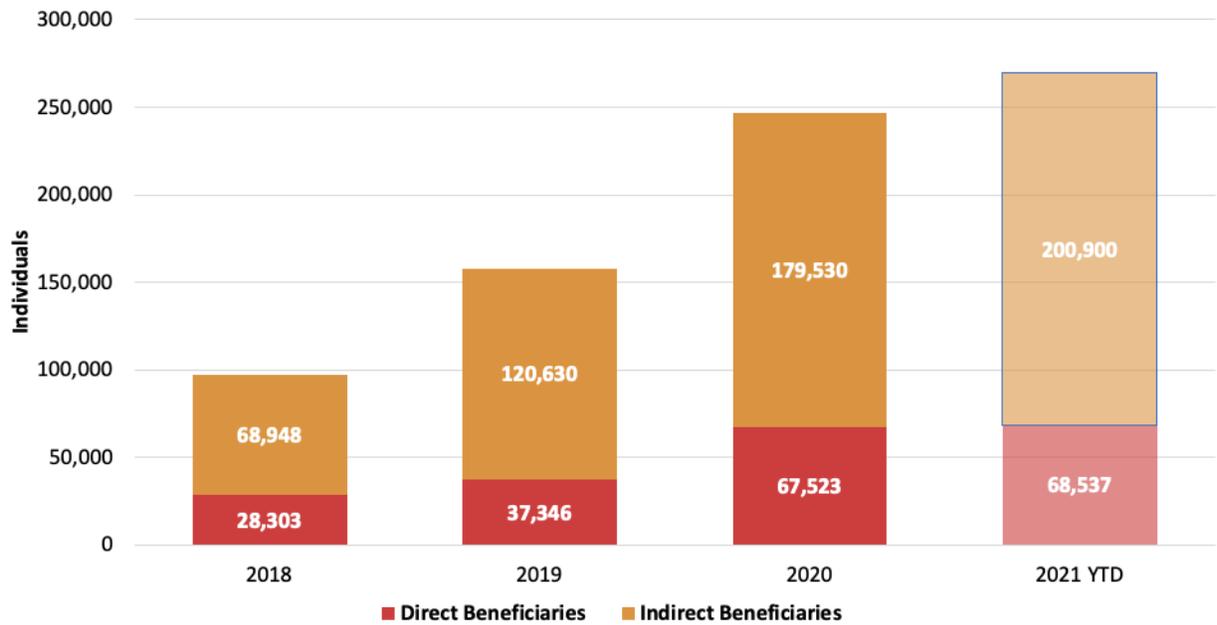


Figure 4: Direct² and indirect³ beneficiaries per year

² Direct beneficiaries are the farmers who planted biofortified seed and their families.

³ Indirect beneficiaries are the estimated number of individuals who consumed biofortified maize by buying from the market.



SALES

Summary:

- Semilla Nueva's sales increased 15% over the same period in 2020, reaching 2,826 bags. We have already met 71% of our 2021 target of 4,000 bags.
- We faced significant challenges again this year. Guatemala's low vaccination rate led to continued restrictions and two of the six sales team members contracted COVID-19 during the sales season. As a result, Semilla Nueva's sales team did far fewer promotional activities than planned. The aftermath of Hurricanes Eta and Iota also led to delayed planting in Eastern Guatemala, our most important sales region.
- Low seed performance and financial penalties related to grain size and color in 2020 led to a significant decrease in sales in Guatemala's southern coast, which was mentioned as a likely outcome in our previous report. New marketing strategies and focus on areas where the seed sales performed better - especially in Eastern Guatemala - led to increased sales which more than made up for this decrease.
- Farmer complaints decreased by 50% from 2020.
- Semilla Nueva began a commercial pre-launch of our new biofortified seed, Fortaleza F5. It was planted in 36 demonstration parcels and provided to dozens of farmers to make a large promotion campaign possible in late 2021 and sales in 2022.

COVID-19 and hurricanes significantly limited sales activities

Although there were more opportunities this year than during the peak of the lockdown in 2020, COVID-19 restrictions severely limited promotion events and field days, both in frequency and in the number of participants. We were only able to carry out 63% of the promotional field activities planned this semester, through which we reached 1,754 farmers in 105 events.

In addition to the local and national travel and meeting restrictions, our sales leaders for both Northern Guatemala and Southern Guatemala were diagnosed with COVID-19 at the peak of the sales season. Both team members recovered, but these two regions fell the furthest behind in sales.

Last year's late season hurricanes, Eta and Iota, caused a delay in the bean and maize harvests in Northeast and Eastern Guatemala and led to significant grain losses from rot. This created uncertainty for farmers in 2021. In addition, there was an increase in prices of fertilizers and agrochemicals due to the international rise in freight rates. Both factors also tended to depress sales.

Radio advertising made a difference during the pandemic

This year radio advertising was a key promotional tool for Semilla Nueva, as the pandemic restricted more direct approaches. Radio spots were designed around the new marketing strategy: "The best tortilla at the best price". Spots aired in 5 local stations in the important maize growing regions of the country: 1 in the Southwestern region, 2 in the Eastern region, 1 in the Southeastern region, and 1 in the Northern Region, with a frequency of 10 spots per day per station. For the first time in Semilla Nueva's history, messages for the northern region were transmitted in Mayan Q'eqchi', the language of 80% of the population in that area.



First semester sales summary: 71% of the year's goals

During the first semester of the year, Semilla Nueva sold 2,826 bags of Fortaleza F3 through agro-dealers, increasing sales 15% compared to the same period last year, and representing 71% of the 2021 sales goal (4,000 bags of Fortaleza F3). In the first 6 months of 2021, we reached 95% of the total volume that was sold during 2020 (Table 2).

In addition to the factors mentioned above, there were several other factors that led to variations in sales of Fortaleza F3 in the various regions of Guatemala. These included: a) poor yield performance in some areas; b) limitations in the yield and price penalties based on smaller grain size and darker grain color; c) a local seed company being subsidized by Semilla Nueva to sell biofortified seed; and d) the Guatemalan government producing and providing free biofortified seeds to an estimated 30,000 to 60,000 farmers. Each of these factors will be explained below for each region.

But first, it is important to note that many of the problems experienced in 2020 with seed quality were solved in 2021. There was a record low claim rate from agro-dealers and farmers this planting season. Only six complaints were received involving a total of 20 bags and representing less than 1% of the total seed sold. Half of the claims came from farmers who reported poor germination rates, and the other half were from the agro-dealers related to poor seed appearance. All claims were resolved by the sales team.

Table 2: Fortaleza F3 bags sold by region and year

Region	2017	2018	2019	2020	2021		
	Total Sales (Bags)	Total Sales (Bags)	Total Sales (Bags)	Total Sales (Bags)	Planned Sales (Bags)	Actual Sales YTD (Bags)	% Achieved
Eastern	-	512	985	1,556	2,000	1,908	95%
Northern	3	139	315	572	800	503	63%
Southern Coast	34	583	826	712	950	299	31%
Highlands	-	-	57	141	250	116	46%
Total	37	1,234	2,183	2,981	4,000	2,826	71%

Eastern Guatemala: In the eastern region, sales in the first six months of 2021 reached 95% of the goal for the year. A new field technician hired in Southeastern Guatemala was particularly effective, increasing sales in this subregion to 528 bags compared to 340 bags the previous year. Since this is a new area, it is important to observe the repurchase rate⁴ in 2022 to ensure that this growth is sustainable and that our material performs well.

Northern Guatemala: In the northern region, sales were limited for two reasons. First, many agro-dealers failed to pay their debts to our distributor in 2020, causing the distributor to cease working with these retailers. This significantly decreased the availability of our seed in 2021. Second, the technician responsible for the region was COVID-19 positive at the peak of the sales season.

⁴ Percentage of farmers that buy seed again in the next growing season.



Southern Coast: In the southern region intermediaries apply price penalties on biofortified maize for consumption, due to the smaller, darker grains. As a result, very few farmers who used biofortified seed in 2020 bought seed again for this growing season. Additionally, yields of Fortaleza F3 in this region continue to be below average, due to high temperatures and high humidity. Generally, this region is increasingly oriented to almost exclusively high-end hybrids, while the Fortaleza F3 is best for the lower market segment. Sales in this region through June were only 31% of the 2021 goal and slightly more than 40% of the total volume sold during the same period in 2020.

Western Highlands: For the Highlands region, sales were similar to the previous year, with significant complications due to COVID-19 restrictions and our sales area limited due to partnership requirements with USAID. In 2022, Semilla Nueva will expand beyond our current target municipalities, which should lead to increased sales.

Conclusion

Semilla Nueva launched sales of our first biofortified seed, Fortaleza F3, in 2018 in order to prove that biofortified seeds could be commercially viable. In certain regions of Guatemala, we have shown conclusively that they are. We have also learned some critical lessons, such as: 1) F3 does not reliably perform well under hot and humid tropical conditions; 2) grain appearance in certain critical markets like the southern coast can be limiting factors; and 3) the unexpectedly strong commercial sales in Guatemala's most malnourished and marginalized region, the western highlands, suggests an important opportunity. Fortaleza F3 has been a good starting tool, but it is reaching the extent of its commercial potential--further commercial expansion will require new biofortified seeds with higher yields and improved grain appearance.

In the second semester of 2021, we will begin large-scale promotion of our second biofortified seed, Fortaleza F5. This seed will allow us to offer a new possibility for sales growth in 2022-2023 while we wait for significantly improved seeds from our own breeding program, see page 23.



SEED PRODUCTION

Summary:

- Semilla Nueva produced enough seed for annual sales, despite crop losses from Hurricanes Eta and Iota, as mentioned in the July-December 2020 Standard Report.
- The quality problems mentioned last year (low germination rates and abnormal plants) were addressed this year, by:
 - Increasing seed production in regions with lower humidity during harvest season and more careful inventory management with agro-dealers
 - Improving quality control with out-growers, who eliminated abnormal plants during seed production.
- Production costs for Fortaleza F3 seed stayed the same as in previous years
- Lessons learned from producing our first seed, Fortaleza F3, will allow us to minimize problems in the commercial production of our new seed Fortaleza F5, beginning in late 2021.

Seed Production increased this year

Five contract farmers planted 27 hectares to produce Fortaleza F3 seed between August and November 2020, representing 59% more area than 2019. Three hectares were planted in the department of Jutiapa and fifteen in the department of Chiquimula, both in eastern Guatemala. The remaining nine hectares were planted in the department of Retalhuleu on the southern coast. All but one farmer had previously produced seed for Semilla Nueva.

In total, 4,106 bags of Fortaleza F3 were produced. We were able to reduce the cost per bag in the eastern region (Chiquimula and Jutiapa) compared with previous years, despite the climatic conditions presented during the season (Eta and Iota hurricanes) and the rigorous quality control imposed. During production, nearly 13.5% of plants were removed due to abnormalities.

The cost per bag increased by 20% in the southern coast where diseases and hurricanes significantly impacted production.

Table 3: Historic and current Fortaleza F3 seed production costs (US\$ per bag)

Fortaleza F3 (Costs per bag, US\$)	2018-2019 Main Season	2019-2020 Main Season	2020-2021 Main Season
Seed Production Contracts	24	28	28
Processing Fees & Seed Treatment	3	3	3
Field to Processing Site Transportation	1	1	1
Bags, Labels & Quality Control Tests	2	2	2
Total Expenses	30	34	34
Bags Produced	3,054	3,641	4,106

While Semilla Nueva's overall costs remained the same, margins for our contract farmers decreased significantly due to impacts from Hurricanes Eta and Iota as well as the increased quality control costs required, as visible below in Table 4. These decreased margins have led to renegotiations of prices and will probably increase production costs for Fortaleza F3 in the 2021/2022 production season. Semilla



Nueva is beginning a far more rigorous initial quality control process with the new Fortaleza F5, which should decrease these additional costs with the new material.

Table 4: Historic and current Fortaleza F3 seed production costs and income for contract farmers (US\$/Ha main seasons)

Farmer's Seed Production Cost For Main Seasons (US\$/ha)	2018-2019 Chiquimula	2019-2020 Chiquimula	2019-2020 South	2020-2021 Jutiapa	2020-2021 Chiquimula	2020-2021 South
Fixed Expenses (rent, water, electricity)	939	921	865	1,278	1,240	1,035
Field Inputs (Fertilizer and Pesticides)	1,101	1,442	775	1,150	1,232	941
Field Planting and Management Labor	950	720	656	512	360	298
Detasseling, Harvest, Cleaning and Drying, Transportation	633	692	437	707	948	587
Total Expenses	3,623	3,776	2,733	2,553	2,646	2,002
Seed Yield (Mg/ha)	4	5	3	3	5	3
Revenue (Expected)	5,387	6,930	3,758	2,257	3,638	2,107
Gross Margin Before Taxes (Expected)	1,764	3,154	1,025	-296	993	105

Semilla Nueva found solutions to the seed quality problems discovered in 2020

A portion of 2020's seed had significant quality control problems. Over a quarter of seed produced had germination rates that fell significantly shortly after harvest, decreasing yields for farmers and causing over a quarter of our commercial seed to be discarded. Seed also had issues with a significant number of abnormal plants which lowered yields and incomes as well as decreased farmers' perception of Fortaleza F3.

Semilla Nueva established tests of seed produced in three different regions and stored in four different environments. The final results confirmed the initial findings included in the previous report. Producing Fortaleza F3 in regions with high humidity during harvest led to seed with falling germination rates. As a result, in 2020, Semilla Nueva concentrated seed production in more suitable regions and also reduced storage time in non-favorable conditions. As Semilla Nueva increases its seed production, the seed drying process will become an even larger challenge.

Quality control efforts also allowed Semilla Nueva to decrease the proportion of abnormal plants in seed production, although they weren't eliminated in their entirety. This effort did decrease the gross margin for contract farmers. Further improvement of our genetic seed is necessary. Semilla Nueva launched a comprehensive genetic review of its parental seed. The initial findings confirmed our suspicions. Our parental seed is not fully genetically pure, with genetic abnormalities present both in our reserve of the first seed we had imported from our partner, CIMMYT, and additional abnormalities



found in later seed produced by Semilla Nueva. Using a more rigorous approach in seed production of our next seed, Fortaleza F5, will allow us to minimize these problems. Additional efforts will be applied both to how we produce parental seed and to ensure genetic purity even from our trusted partners.

Semilla Nueva will produce 5,500 bags in the 2021-2022 production year

Semilla Nueva's plan for next season is to produce 5,000 bags of Fortaleza F3 and 500 bags of the new biofortified hybrid, Fortaleza F5. To do this, we will need to increase our seed production area by 30% to approximately 35 hectares. All the parental seed to be used for future Fortaleza F3 seed production is coming from the new parental seed production program, which follows an improved cleaning process and more intensive quality control to reduce the presence of abnormal plants.



MARKETING – FARMER INTELLIGENCE

Summary:

- Semilla Nueva launched a new program with Guatemala’s largest seed company to pilot the use of incentives to make biofortified maize seeds more accessible to small farmers. Semilla Nueva’s team was partially successful in reducing the final price to farmers. Additional coordination and programs will be needed to reduce the price to desired levels and target the correct farmers.
- Semilla Nueva continued our promoter program, placing temporary employees in agro-dealers during the sales season to collect contact information from farmers who purchased seed as well as directly promote Fortaleza F3 seed.

Semilla Nueva was able to reduce the price of its seed

In late 2020, Semilla Nueva negotiated a deal with Guatemala’s largest national seed company, Valle Verde. Both organizations recognize that current biofortified seeds are less profitable for seed companies than currently available non-biofortified seeds. Both agreed to pilot a subsidy model, wherein a simulated governmental incentive (provided by a donor) would be paid if both organizations sold biofortified seeds at reduced prices and targeted the poorest farmers. Valle Verde’s results are discussed in the Collaborations - Public Policy section below. Semilla Nueva’s results are discussed here.

Semilla Nueva’s 2020 market survey results showed that Fortaleza F3 is 17-23% more expensive than Guatemala’s cheapest and most common non-biofortified hybrid seed, HB-83. Using margins negotiated with Valle Verde, Semilla Nueva worked to decrease the final price of Fortaleza F3 seed to small farmers. We negotiated with distributors to decrease their price and for them to pass on this savings to agro-dealers. By reducing the distributors’ price and increasing the margin percent for both the distributors and agro-dealers, Semilla Nueva hoped to reduce the suggested retail price of the 20 kg Fortaleza F3 bags from US\$58 to US\$39, even lower than HB-83. Agro-dealers and distributors resisted the strategy, and a final price structure for the first year was developed which would maintain similar absolute margins for both the agro-dealers and distributors. The final suggested retail price of Fortaleza F3 was set to US\$45 per bag, at the same level as HB-83.

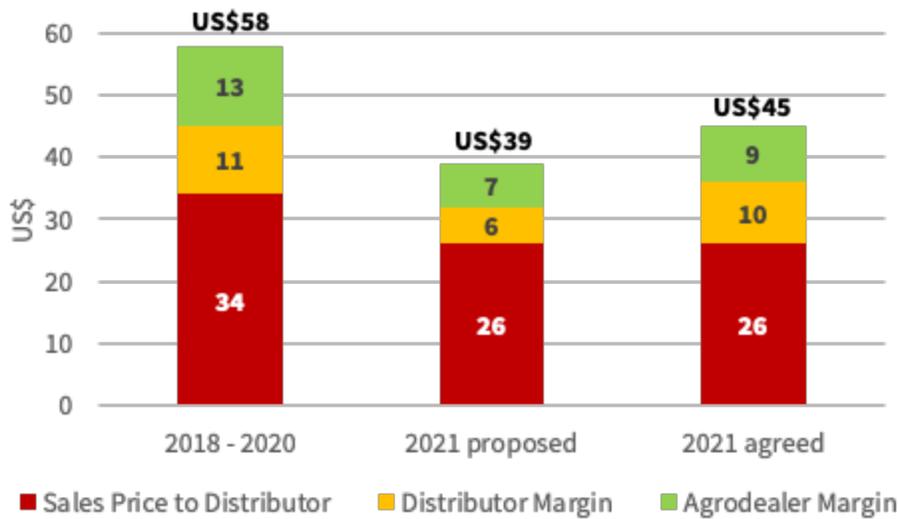


Figure 5. Price for farmers and margins for distributors and agro-dealers of Fortaleza F3 20 Kg bag (US\$)

Market surveys this year showed that the actual farmer price oscillated between US\$42 and 45 in the Southern region, but in most other regions, Fortaleza F3 was still sold at the 2020 price. Semilla Nueva wanted to publish the suggested retail price, but found considerable resistance from the agro-dealers, especially the more remote ones, as their price structure is different due to transportation costs. Agro-dealer compliance will be a significant focus for the rest of 2021 and in preparing for the 2022 season.

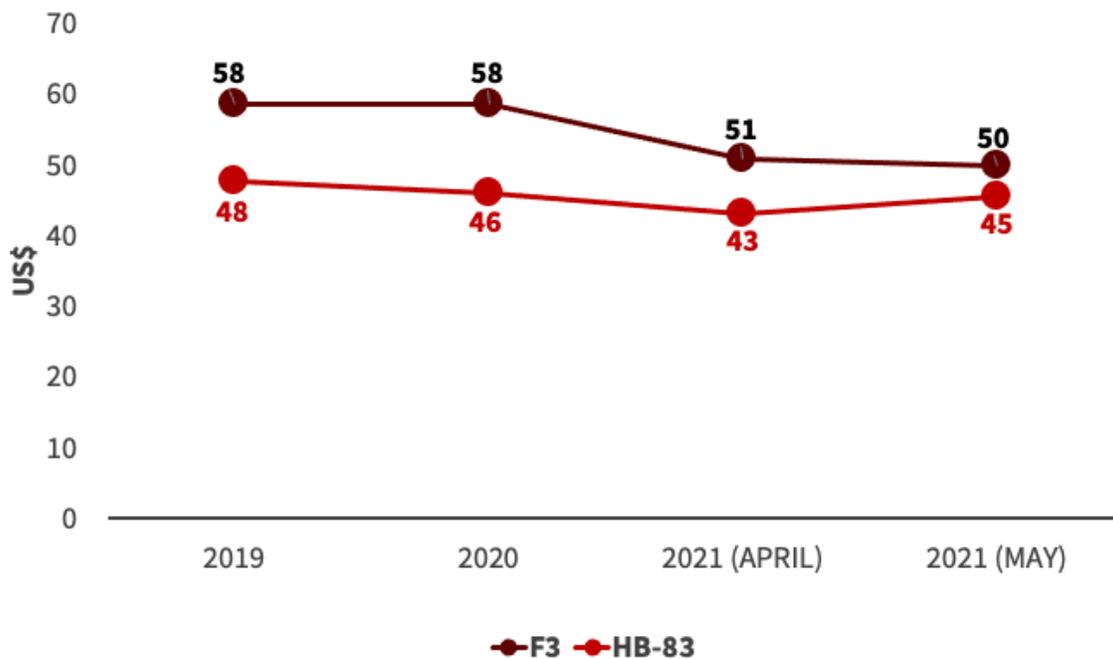


Figure 6: Comparison of average seed price (US\$) per 20 Kg bag of Fortaleza F3 and the conventional HB-83 during three years



Semilla Nueva sees the importance of developing an incentive program for two reasons. First, we want to develop a mechanism that will increase the adoption of seed by poorer farmers who normally don't purchase seed due to its cost. Second, our current analysis shows this mechanism to be the most cost-effective way to move the Guatemalan seed industry to large-scale adoption. Both of these factors lead us to believe that a successful incentive program is the most cost-effective public policy that the Guatemalan government could adopt to significantly reduce chronic malnutrition.

Promoters program was successfully expanded to more agro-dealers

Last year, Semilla Nueva launched the use of “promoters” - temporary local staff hired to visit agro-dealers, directly promote Fortaleza F3 to farmers, and collect data from these farmers for follow up surveys. In the 2021 main sales season, we expanded this pool of promoters to 15 with the goal of collecting contact information from 900 farmers. The team encountered some resistance in registering farmer contact information; only 714 farmers were willing to share their information, representing nearly 80% of the yearly target. Unfortunately, only 553 provided a telephone number. The M&E team followed up within a week with each newly registered farmer to verify contact information and willingness to take part in follow up surveys; a total of 398 farmers agreed. Twenty-eight farmers reported planting both Fortaleza F3 and another commercial seed on the same date. This group will be the basis for studies on comparative economic performance of Fortaleza F3. Additional measures, such as a raffle, may be used in 2022 to increase farmer participation and access to phone numbers.

Semilla Nueva modified its marketing campaign: “the best tortilla at the best price”

Semilla Nueva refined its marketing slogan to combine both the economic benefits of Fortaleza F3 seed and the tastiest tortillas produced from its grain. The new slogan “The best tortilla at the best price,” was included in new marketing materials and launched nationally.



Figure 7: Example of new promotional materials for 2021 Fortaleza F3 campaign



COLLABORATIONS – PUBLIC POLICY

Summary:

- A coalition of many of Guatemala’s leading nutrition and agriculture organizations provided the Guatemalan government with a consolidated list of policy recommendations to increase the use of biofortified maize.
- The Guatemalan government has made biofortified maize seeds one of its priorities for rural development and launched a biofortified seed donation program to reach 30-60,000 farmers.
- Guatemala’s largest national seed company worked with Semilla Nueva to pilot an incentive program. They reached just under 1,000 families the first semester.
- Semilla Nueva continued programs to donate non-commercial quality biofortified seed to subsistence farmers through partnerships with farming associations and NGOs.

Work with other institutions coalesces into a consolidated list of policy recommendations for the Guatemalan government

In 2015, Semilla Nueva co-led the formation of the BioFort Platform, a coalition to coordinate efforts to scale biofortified seeds. In 2020, Semilla Nueva took a renewed leadership position in the interinstitutional work group. The workgroup strengthened alliances between Semilla Nueva, the Guatemalan Government’s Institute for Agricultural Sciences and Technologies (ICTA), and several other leading agricultural and nutritional leaders, including the INCAP. This workgroup created a list of policy recommendations for the Guatemalan government, hosted several events and meetings with top government officials, and provided numerous interviews. The recommendations include:

1. Provide additional funding to the Guatemalan government’s research program (ICTA) for development of new biofortified seeds
2. Institutionalize the free seed distribution program in the Guatemalan government’s budget
3. Purchase primarily biofortified grain for social programs
4. Incentivize seed companies to sell biofortified seeds to small farmers at reduced prices.

Guatemalan government efforts stall on creation of a grain reserve, but launches the largest free biofortified maize seed distribution program in Latin America

The Guatemalan government began making biofortified seeds an increasing priority in 2020, thanks in part to efforts summarized in the previous two standard reports. By early 2021, the Minister of Agriculture began mentioning biofortified seeds in his major public speeches, including in several events with USAID and the Guatemalan private sector. The Guatemalan government successfully began free distribution of biofortified seeds in April 2021, with the majority of seeds provided in the months of May and June. The government estimates that seeds were provided to 30-60,000 families, but Semilla Nueva has been unable to confirm exact numbers. The program has been seen as successful both inside the Ministry of Agriculture and by numerous independent actors, and the government has plans to double its size in 2022.

Semilla Nueva assisted efforts to plan the creation of a biofortified grain reserve. The government planned to purchase 5,000,000 lbs. (equivalent to 2,273 Mg) of biofortified maize each year and then



distribute it during emergencies or to underserved communities. The program was tied into the 2020-2021 national budget, which was rescinded by the Guatemalan congress. There are plans to include it in the 2021-2022 budget, but it is on hold until then.

Semilla Nueva's efforts to establish a biofortified seed subsidy program proved to be fruitful. The Minister of Agriculture expressed support for Semilla Nueva to pursue funding from USAID to scale the seed incentive program, and for the Ministry to take a lead role in project implementation. If funding is obtained, the Ministry would be able to take significant credit for the impact of the program, which would help in obtaining support to institutionalize it.

Seed incentive program pilot with Guatemala's largest national seed company is initially successful

In October 2020, Semilla Nueva signed an agreement with Valle Verde (Guatemala's largest national seed company). For every bag of biofortified seed sold to farmers at a reduced price, Semilla Nueva provides Valle Verde a financial incentive to defray the associated additional costs. Semilla Nueva sent Valle Verde parental seed to produce and sell ICTA HB-18 (the generic government name for Fortaleza F3). Valle Verde planted 11 hectares for seed production last year and successfully harvested during March 2021. For context, Semilla Nueva produced 27 hectares in the same season. The Semilla Nueva production coordinator visited their production field twice to supervise and advise. Seed yield was lower (2.5 Mg/ha) than our lowest production region but was far higher than Valle Verde's previous attempts to produce biofortified seeds. Seed germination was excellent (96%).

Valle Verde produced 1,050 20kg bags of seed. Since their harvest was late for the primary sales season, they were able to sell only 526 bags. They plan to continue sales during the second sales season in Northern Guatemala. As agreed, they concentrated sales in the northern region, in municipalities where Semilla Nueva is not yet working. Valle Verde sold its seed at the predetermined reduced price, as specified in the agreement. Semilla Nueva completed the first payment of incentives by late June thanks to the support from the Innocent Foundation and the Light a Single Candle Foundation.

Success on a seed incentive model with Valle Verde would be a powerful proof of concept and a solid starting point for collaborations with the Guatemalan government and international donors. Over the next six months we will be working with Valle Verde to test our new Fortaleza F5 seed and explore their involvement in expanding the program both geographically and in terms of volume.



Figure 8: Leonel Chavez, Valle Verde’s owner, during seed processing and holding the first bag of ICTA HB-18

Farmer cooperatives, supported by Semilla Nueva massively increased sales to the government - but sales to small farmers decreased

Since 2017, Semilla Nueva has supported two farmer cooperatives to produce and sell biofortified seeds to farmers in the Eastern region. These two cooperatives continued selling some seed to farmers in 2020, but most sales were diverted to provide the Guatemalan government with the seed for their free seed distribution program. We have not completed analysis of the impact of the Guatemalan government’s program, and so only seed sold to farmers, about 6,000Kg each, were considered in our impact calculations. Both farmer cooperatives are interested in continuing their sales and are highly interested in access to new, improved biofortified seeds.

Partnerships with other organizations

Semilla Nueva launched two projects to help subsistence farmers, both using seed that Semilla Nueva cannot sell commercially; this seed is still better than the seed subsistence farmers usually use. Seed produced in 2020 with germination rates lower than commercial standards was provided to the farming association APROCAFIL, with 272 bags for 761 families, and the international NGO, World Vision, with 152 bags for 666 families. The latter agreed that in exchange for the seed they would use Semilla Nueva’s methodology to study the economic impact of biofortified seed on subsistence farmers in the Eastern region, one of Guatemala’s most marginalized regions. The study is underway and will be published in late 2021. Seed discarded for being too small was provided to the organization FEDECOVERA as part of a grant with Rotary International. This seed which was otherwise of high quality was provided to farmers directly, with the plan to provide it at a reduced cost to farmers in 2022 if the project proves successful.



RESEARCH AND DEVELOPMENT

Summary

- Semilla Nueva's breeding efforts are on track to significantly mitigate the major challenges that we have uncovered with existing biofortified maize seeds. The techniques we are developing will also allow us to rapidly develop seeds that can make Semilla Nueva financially sustainable and open expansion to other countries in both Latin America and Sub-Saharan Africa.
- Semilla Nueva's biofortified maize seed development program has passed its most important first proof of concept. Higher yielding, disease resistant seeds are 75% converted (BC1 stage) while maintaining 90-100% of the nutritional levels of our current biofortified seeds. Additional testing and selection is required. New experimental hybrids will be ready for testing in 2022, with projected launches in 2024-5.
- Semilla Nueva installed, staffed, and began running its own micronutrient laboratory to evaluate zinc and iron in newly developed seeds. The program has analyzed four times as many samples in its first six weeks than Semilla Nueva had analyzed with third parties in the previous six years. This capacity will allow seed development to be done in-house, at far lower costs and more quickly.
- Semilla Nueva created new experimental hybrids for testing and continued to test new seeds from our partner, the International Maize and Wheat Improvement Center (CIMMYT). Two of these seeds have far higher yields than both our current Fortaleza F3 seed and the Fortaleza F5 seed we will launch next year. One new hybrid has significantly improved grain size and color, which will help address the problems seen in important regions with low repurchase rates, such as Guatemala's southern coast.

Semilla Nueva launched an in-house lab for determination of micronutrients, specifically zinc and iron

In early 2021, Semilla Nueva installed a laboratory sample grinder and installed and calibrated a new XRF spectrometer to analyze zinc and iron in ground samples. The spectrometer is of a new class (HD-XRF) with potential for far higher levels of accuracy, and which hadn't been used previously in biofortified crops. The calibration was successful, and results had a high correlation with the far more expensive, industry standard methods used by CIMMYT (R^2 0.93 for zinc; R^2 0.71 for iron when compared to ICP). Semilla Nueva hired an experienced laboratory technician, Ana Marquez, who began analyzing the results of Semilla Nueva's breeding programs to date (Fig. 9). The funding for this lab was provided thanks to an additional grant provided by Swiss Re and funding from Light a Single Candle Foundation. We are immensely thankful to both organizations.



Figure 9: Left figure: equipment for zinc and iron analysis (left), and equipment for grinding (right); Right figure: Lab Technician, Ana Marquez, using the XRF nutritional analyzer for maize samples

The new laboratory processes 180 samples per week. An expansion of the grinder has been ordered and an additional assistant will be hired, allowing an increase to 1,000 samples per week by the end of 2021. To put this into perspective. Semilla Nueva had analyzed 300 samples with CIMMYT over the previous six years, compared to over 1,000 samples in the six weeks prior to writing this report. Evaluating one sample from each new seed, Semilla Nueva will be able to significantly expand its breeding efforts, evaluating over 1,000 new seeds every week.

Semilla Nueva completed the equipment to launch a lab for protein quality with the Institute of Nutrition of Central America and Panama (INCAP)

Semilla Nueva purchased the remaining equipment to launch a laboratory in INCAP to analyze the amino acid levels (protein quality) in maize samples using live bacteria. The protocols and procedures are in process, although the collaboration has had significant delays because of staffing and administrative hurdles due to COVID-19. The lab may be in full operation by September 2021.

Nutritional evaluation of Semilla Nueva's first batch of experimental seeds show we may be able to convert far more competitive seeds to biofortified

In both 2017 and 2019, Semilla Nueva launched efforts to convert non-biofortified commercial seeds originally provided by CIMMYT into biofortified versions through backcross breeding techniques. The non-biofortified hybrids have yields 20-35% above Fortaleza F3 and could be considered high-segment



seeds. While backcross breeding is a standardized process for protein quality traits, it has not yet been used for zinc and iron due to the multiple, unmapped genes that contribute to zinc and iron levels. Semilla Nueva theorized that by simply increasing the number of experimental lines tested, we could compensate for this genetic complexity. Initial results show that this hypothesis may be correct (Table 5).

After the launch of Semilla Nueva's lab, the first thousand experimental seeds were evaluated. These seeds consisted of an attempt to backcross two of CIMMYT's most promising low zinc but high yielding lines (CML576 and CLWQHZN44) to have the same levels of nutrition as in our more nutritious seed lines (CLWQHZN49, CLWQHZN69, and CLWQHZN46). In Table 5 below, the best three lines of each family (white rows) are compared with the original zinc levels from the biofortified line (pink row). Overall, the results show a consistent pattern: it may take the production of several hundred new experimental seeds, but it seems feasible to carry out a conversion process and generate new, biofortified versions of non-biofortified seeds.

Table 5: Preliminary results of zinc evaluation in the backcross breeding

Genotype	Type	Population	Individual Family Number	Zn Average PPM	Percentage of the donor
CLWQHZN49	DONOR LINE			43.16	
CLWQHZN49/CML576 F3	BCOF3	A347	23	39.35	91
CLWQHZN49/CML576 F3	BCOF3	A343	39	38.51	89
((CLWQHZN49/CML576)//CML576) F3	BC1F3	A352	42	37.33	86
CLWQHZN69	DONOR LINE			37.41	
((CLWQHZN44/CLWQHZN69//CLWQHZN44(R1)) F3	BC1F3	A348	8	39.51	106
((CLWQHZN44/CLWQHZN69//CLWQHZN44(R1)) F3	BC1F3	A349	23	38.56	103
((CLWQHZN44/CLWQHZN69//CLWQHZN44(R1)) F3	BC1F3	A349	47	36.46	97
CLWQHZN46	DONOR LINE			36.22	
(CML576/CLWQHZN46)//CML576(R1) F3	BC1F3	A350	46	36.98	102
(CML576/CLWQHZN46)//CML576(R1) F3	BC1F3	A350	45	33.83	93
(CML576/CLWQHZN46)//CML576(R1) F3	BC1F3	A350	14	33.19	92

Semilla Nueva's new Advisory Board member, Dr. Michel Ragot (Managing Director at Nouvelle France Genetics and former head of germplasm excellence at Syngenta), is supporting the research team and suggested the use of DNA markers to expedite and increase the accuracy in the backcross program. Semilla Nueva is preparing a preliminary genetic map to identify which genes affect zinc and iron content to find DNA markers that can make the backcross program more efficient.



Figure 10: Backcross nursery at Semilla Nueva experimental center

Semilla Nueva develops new experimental hybrids with improved grain color

Semilla Nueva's research team reviewed nearly 100 older seeds from our partner CIMMYT's seed bank and discovered one that was high protein quality but had a larger seed size and a white cap. Incorporating this seed into an experimental hybrid created a maize ear with larger grain size and a whiter appearance. This difference is apparent (Fig. 11) when comparing 10 grains and one of the ears from this new experimental hybrid (below and left) with Fortaleza F3 (top and right). This new seed is currently being evaluated for commercial potential and is in the registration process with the Guatemalan government. Beyond this specific hybrid, Semilla Nueva is also working to incorporate this trait into our seed development program, as it offers the potential to reduce one of the biggest challenges for high protein quality biofortified seeds in Guatemala.



Figure 11: New experimental hybrid (bottom and left) shows increased grain size and improved color when compared to Fortaleza F3 (top and right)

Semilla Nueva created and is evaluating 361 new experimental hybrid seeds

Beyond backcrossing to convert non-biofortified seeds, Semilla Nueva also launched a “mix-match” approach of combining numerous existing lines to create new hybrids. This approach won’t yield a long-term process that would allow for creating new biofortified seeds but could detect hybrids that could be launched in the next two years. A new set of 361 hybrids, including single, triple, and double crosses, were selected for field screening in two contrasting environments in Guatemala. This screening process will include evaluation of both field performance and nutritional content, compared with local commercial seeds and Semilla Nueva’s existing commercial biofortified seed. Our expectation is to identify 20 to 30 promising materials to be included in a more extensive evaluation in the next growing season (Fig. 12).



Figure 12: Samples of ears from the new hybrids developed with crosses for screening



Two new seeds with high protein quality, zinc, and iron from CIMMYT's breeding program are in an extensive field evaluation for a potential full launch in 2023

After the first year of evaluation in Guatemala, two hybrids from CIMMYT's biofortified sets were selected (CLTHWZN19520 and CLTHWZN19523). In initial trials, these hybrids yielded roughly 25% more than Fortaleza F3. A small amount of each hybrid was received and planted in trials for evaluation and commercial sale approval. We hope at least one of these hybrids will be ready for a commercial launch in 2023 (Fig. 13).

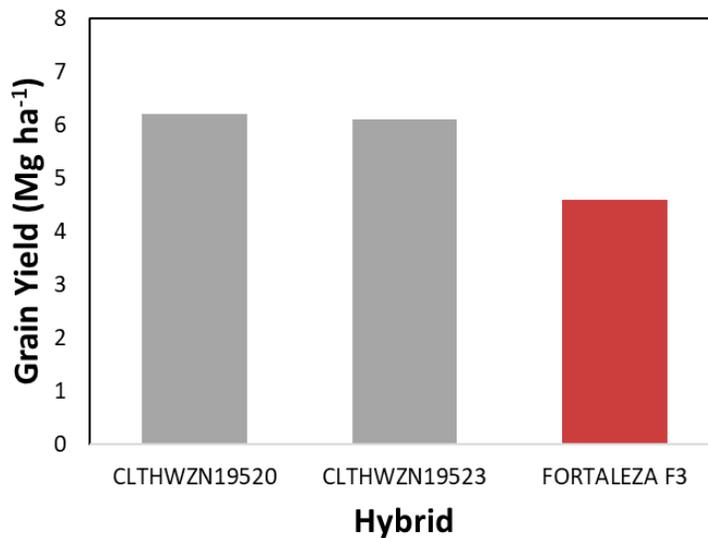


Figure 13: Yields from two experimental hybrids from CIMMYT, compared with Fortaleza F3; Results from six locations, 2020/2021 irrigation season

Conclusion

The majority of Semilla Nueva's budgetary growth in 2021 was invested in our breeding program. As this report explains, the principal limitation for the growth of biofortified maize in Guatemala is the need for higher yielding and more competitive seeds. Semilla Nueva's initial efforts are showing good results. New seeds obtained from partner CIMMYT could be ready for launch in 2023. More importantly, Semilla Nueva has developed the in-house capacity to convert non-biofortified seeds to have more nutrition--a process which will allow both expansion to other countries and a path to help other seed companies biofortify their existing seeds.



FINANCE/ADMINISTRATION/HUMAN RESOURCES

Summary

- As of the end of June, budget execution is 43% out of a planned 55% of the annual budget.
- Semilla Nueva secured US\$745,000 of new and renewed funding in the first half of 2021, reducing its 2021 funding gap to 4%.
- Semilla Nueva completed its second external audit. A full review of US and Guatemalan 2020 finances produced no findings.
- We are in the final phase of an ERP implementation that will improve efficiency and reduce reporting times.

2021 budget vs actual

Semilla Nueva's 2021 approved budget is US\$1,964,780, a 24% increase from 2020. As of June, the budget execution is 43% (US\$850K) out of a planned 55% (US\$1,089K) for this semester. The 12% underspending is mainly due to positions not yet filled, delays in the implementation of the Enterprise Resource Planning (ERP) System (see below), and unrealized R&D laboratory implementation expenses (see Figure 14). These savings will be used to cover funding gaps in 2021 and 2022.

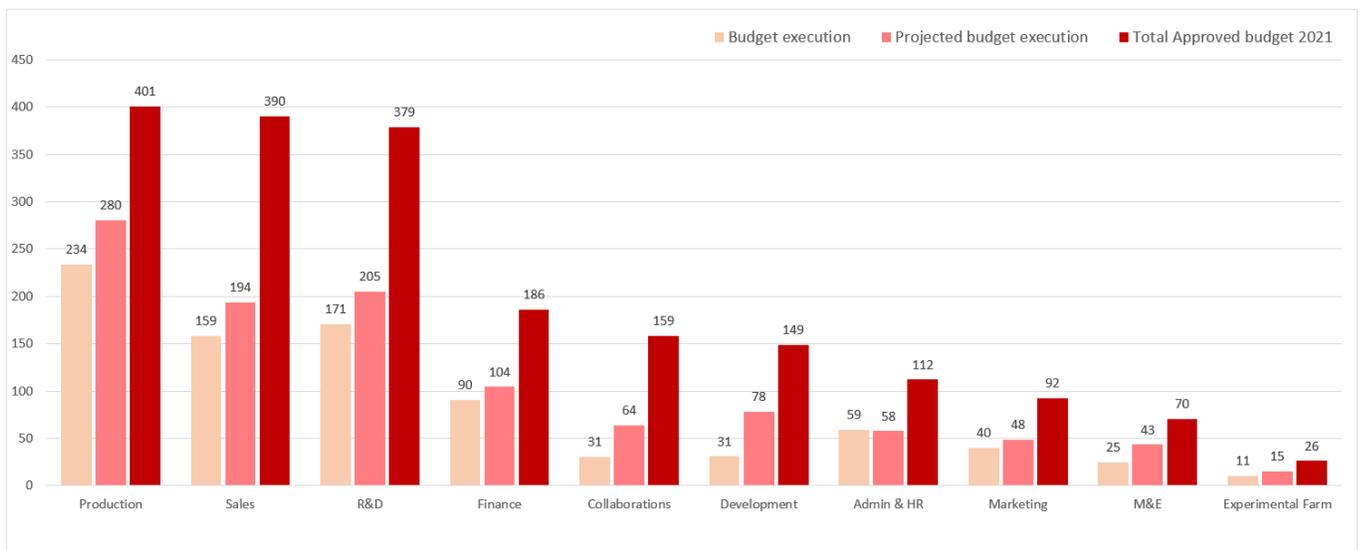


Figure 14: 2021 Budget vs actual

In the first half of 2021, four existing donors renewed funding, and we began a new 2-year agreement with The Vitol Foundation

Four of our donors – Mulago Foundation, Light a Single Candle, the Harbourton Foundation, and one anonymous - renewed their funding agreements with Semilla Nueva for a total of US\$545,000 in the first half of 2021. The Vitol Foundation awarded a 2-year agreement to Semilla Nueva for a total of US\$200,000. In total, US\$745,000 funding was secured, reducing the 2021 funding gap to 4%. 69% of these new funds are unrestricted, and all current donors have agreed to receive our standardized programmatic and financial report, except for US government funds.



For a second year, the external audit of 2020 consolidated financial statements passed without findings

The scope of the audit includes the financial statements and respective transactions of all three SN organizations (US 501(c)3 nonprofit, Guatemalan nonprofit, and our subsidiary Guatemalan company). In March, we received the Independent Auditor's report with an **unqualified opinion**, which indicates that the financial records have been maintained in accordance with the standards known as Generally Accepted Accounting Principles (GAAP). Copies of the 2020 audit report can be requested by emailing Maria Cruz at mariacruz@semillanueva.org.

Semilla Nueva is implementing a new Enterprise Resource Planning (ERP)

In the past Semilla Nueva has used the financial tool QuickBooks to track its accounting records. However, the growth of our operations has increased in complexity and in order to deliver more timely and accurate reports to donors and tax agencies, we decided to adopt a more robust and comprehensive Enterprise Resource Planning (ERP) System. The ESC system selected is currently in final adjustments before it becomes active (Figure 15).

The purpose of this ERP is to improve efficiency and decrease reporting times, as well as to adapt the functionality of presenting individual (by organization) and consolidated financial reports. We especially thank USAID's Feed the Future, Partnering for Innovation program, implemented by FINTRAC, for funding this system.

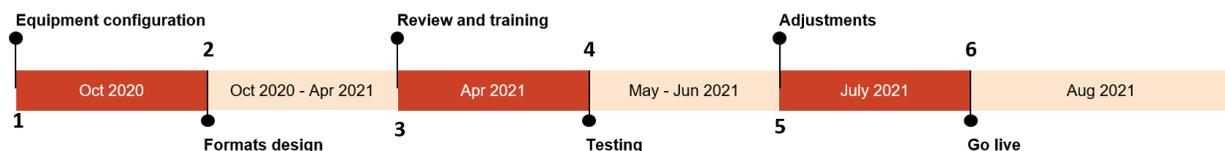


Figure 15: Adoption stages of the Enterprise Resource Planning System

COVID-19 – Financial measures

Since the beginning of the global COVID-19 pandemic, Semilla Nueva has taken several defensive financial measures:

- Sales income reserve: All income from sales made in 2020 and 2021 so far (US\$152K), has been put into a reserve fund. If needed, this fund can be accessed to cover operational expenses, through a request from the Executive Director and approval by the Board Finance and Administration Committee.
- Stricter monitoring of budget execution: All purchases and hires need to have prior approval from the area manager and final authorization from the Finance Manager. Area managers also have more frequent access to budget vs actual reports with in-depth analysis.
- Semilla Nueva was able to retain all current staff during the pandemic, at the cost of putting salary increases and adjustments on hold during 2020-2021.